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## Short-term Effects of Extreme Upwelling on Juvenile Gopher Rockfish (*Sebastes carnatus*)

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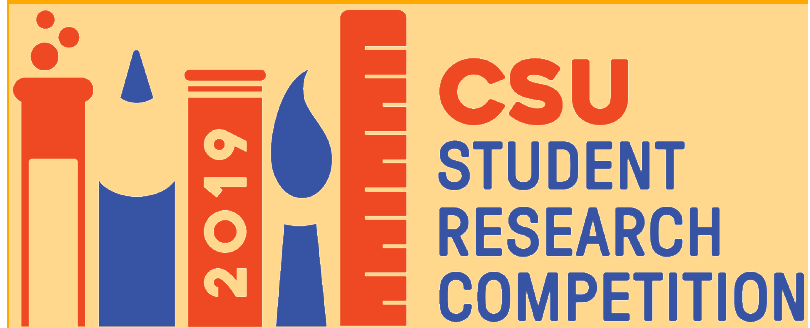
Kashiwabara, Lauren; Baker, Jacoby; Palmisciano, Melissa; Kashef, Neosha S.; Stafford, David; Sogard, Susan; Hamilton, Scott L.; and Logan, Cheryl, "Short-term Effects of Extreme Upwelling on Juvenile Gopher Rockfish (*Sebastes carnatus*)" (2019). *CSU Student Research Competition Delegate Entries*. 16.  
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**Authors**

Lauren Kashiwabara, Jacoby Baker, Melissa Palmisciano, Neosha S. Kashef, David Stafford, Susan Sogard, Scott L. Hamilton, and Cheryl Logan

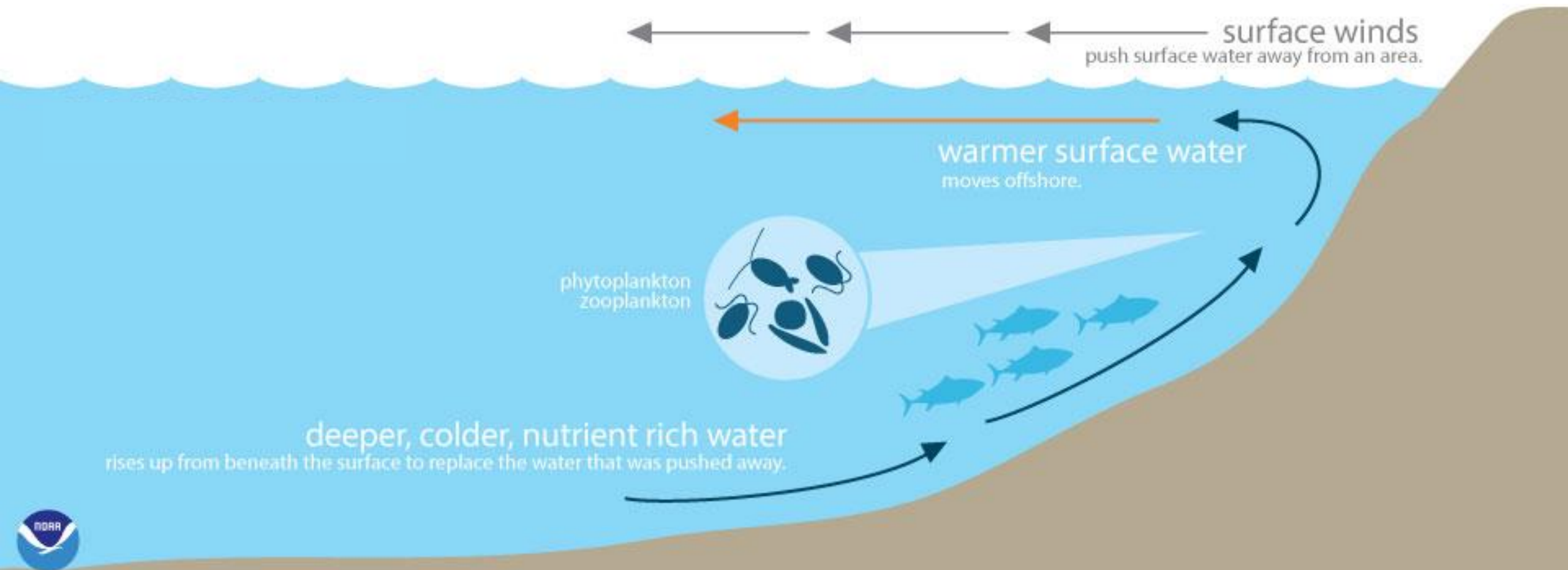


California State  
University, Fullerton  
April 26, 2019

# SHORT-TERM EFFECTS OF EXTREME UPWELLING ON VENTILATION RATES IN JUVENILE GOPHER ROCKFISH

Lauren Kashiwabara, Jacoby Baker, Melissa Palmisciano, Neosha S Kashef, David Stafford, Dr. Susan Sogard, Dr. Scott L. Hamilton, and Dr. Cheryl Logan

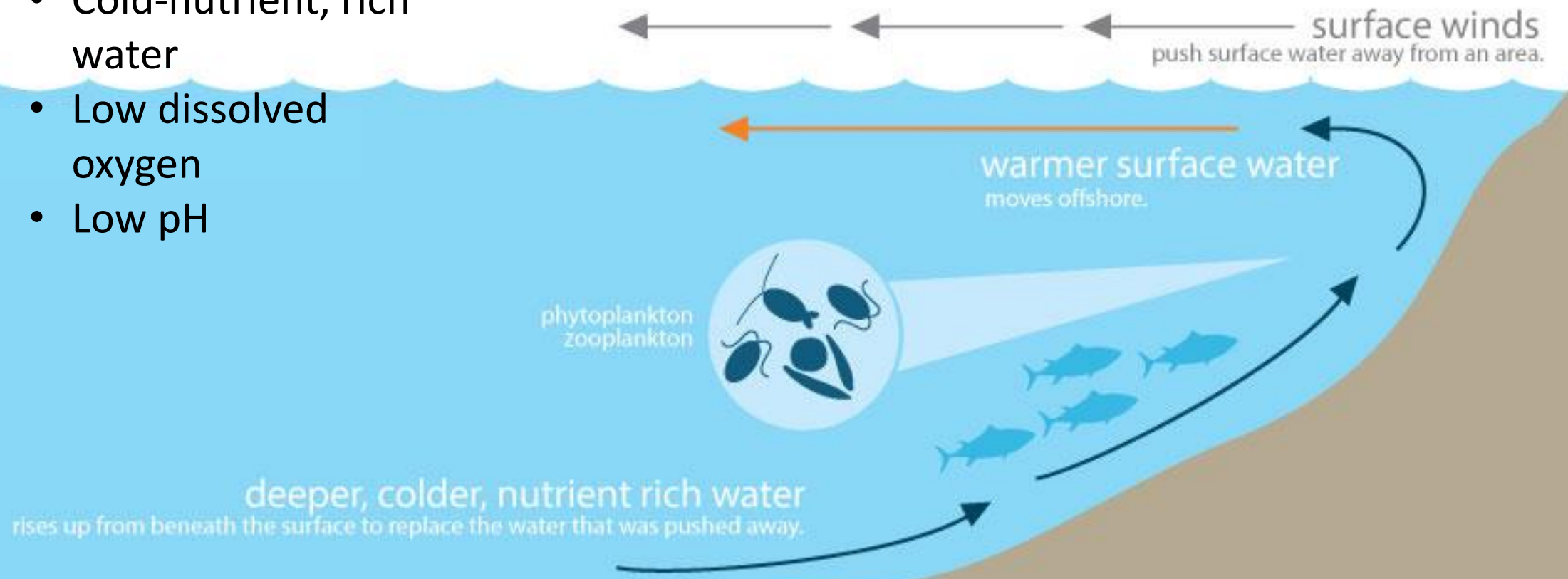
# Upwelling



# Upwelling

## Upwelling

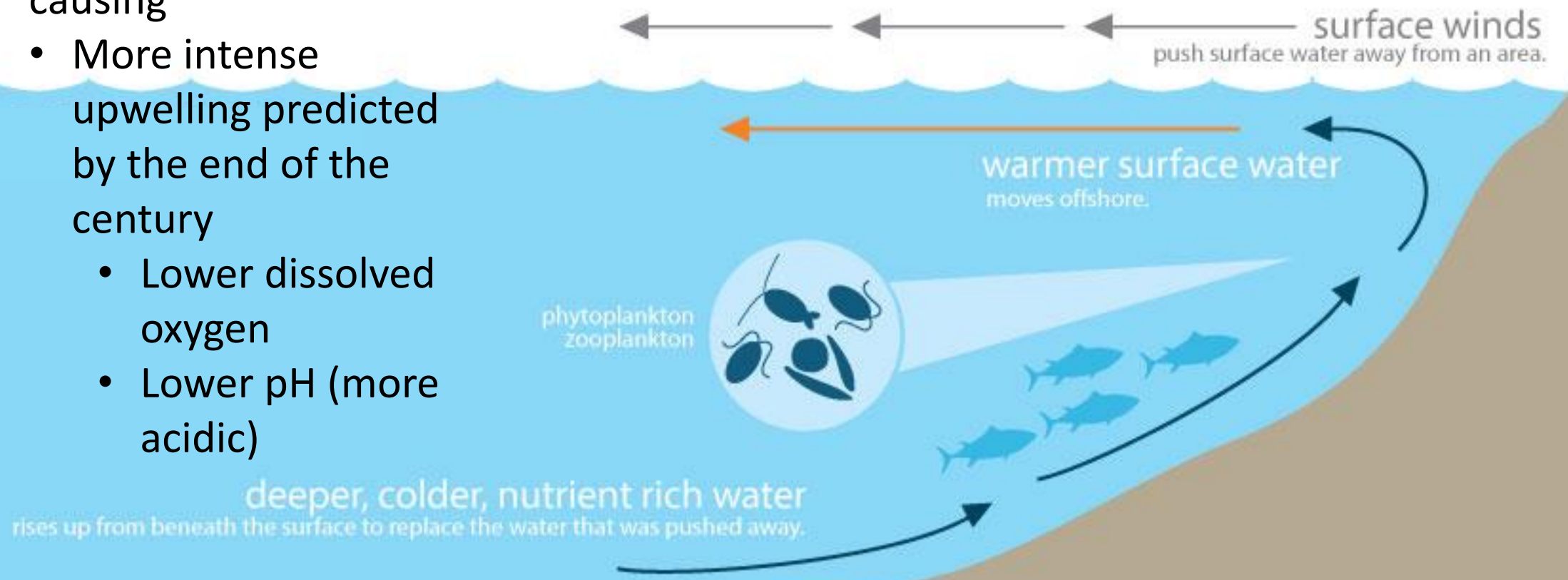
- Cold-nutrient, rich water
- Low dissolved oxygen
- Low pH



# Upwelling and Climate Change

Climate change is causing

- More intense upwelling predicted by the end of the century
  - Lower dissolved oxygen
  - Lower pH (more acidic)



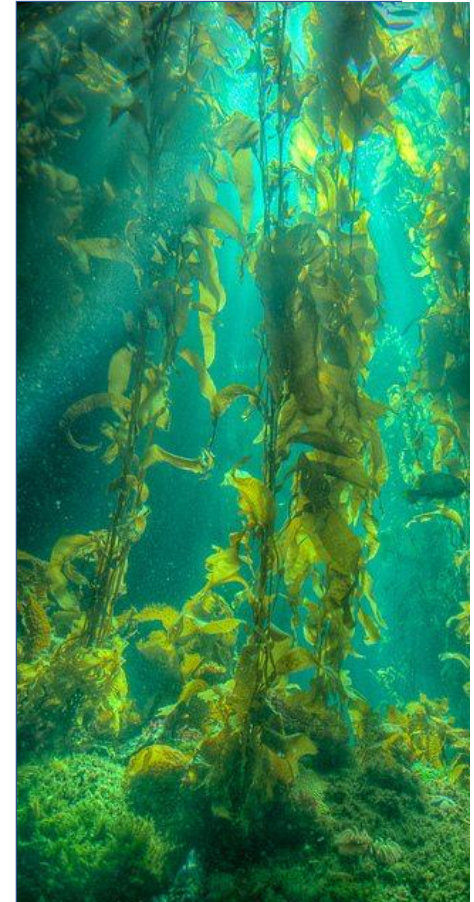


# Juvenile Gopher Rockfish

**Rockfish** over 60 species along the west coast of the US; Ecologically/economically important; Slow growing and reproducing

**Gopher** 1-2 month pelagic larval stage; recruits to kelp canopy April-May

**Juveniles** fish that are approximately four to six months old



# Why ventilation?

## Effects of low DO

- Need to get more oxygen across gills and into blood
- Less oxygen means lowered ability to bind oxygen to hemoglobin
- Essential in brain function

## Effects of low pH

- Many body functions are pH sensitive
- Fish use gills for ion regulation and acid-base balance regulation





# Hypothesis

Question: How will juvenile gopher rockfish ventilation rates respond to a short-term upwelling cycle?

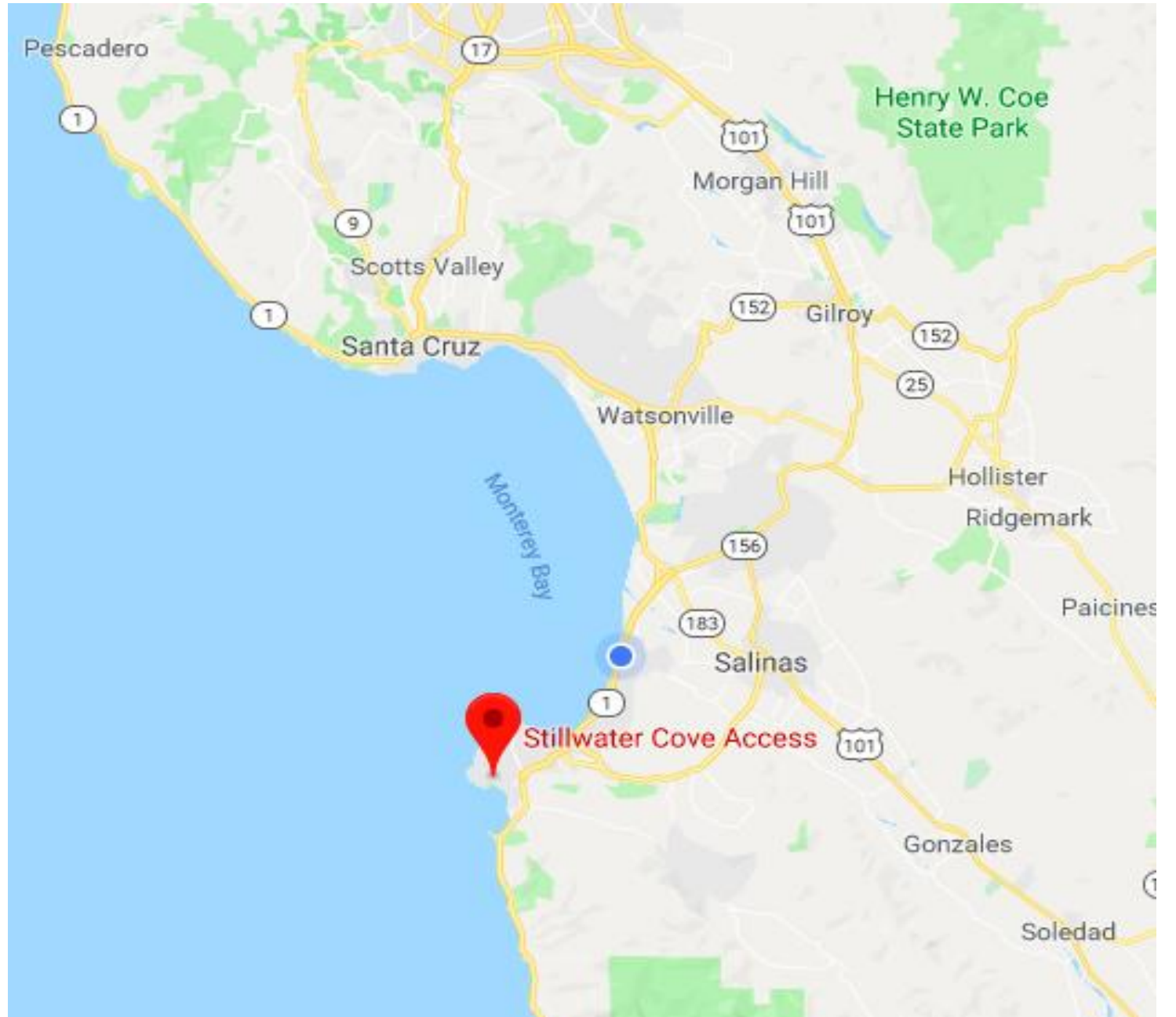
H<sub>1</sub>: Juvenile gopher rockfish will increase ventilation rates when exposed to an upwelling event

H<sub>2</sub>: Juvenile gopher rockfish will decrease ventilation rates when returned to ambient conditions after an upwelling exposure

# Sample Collection



# Sample Collection



# Treatments

## Control Group

n=10

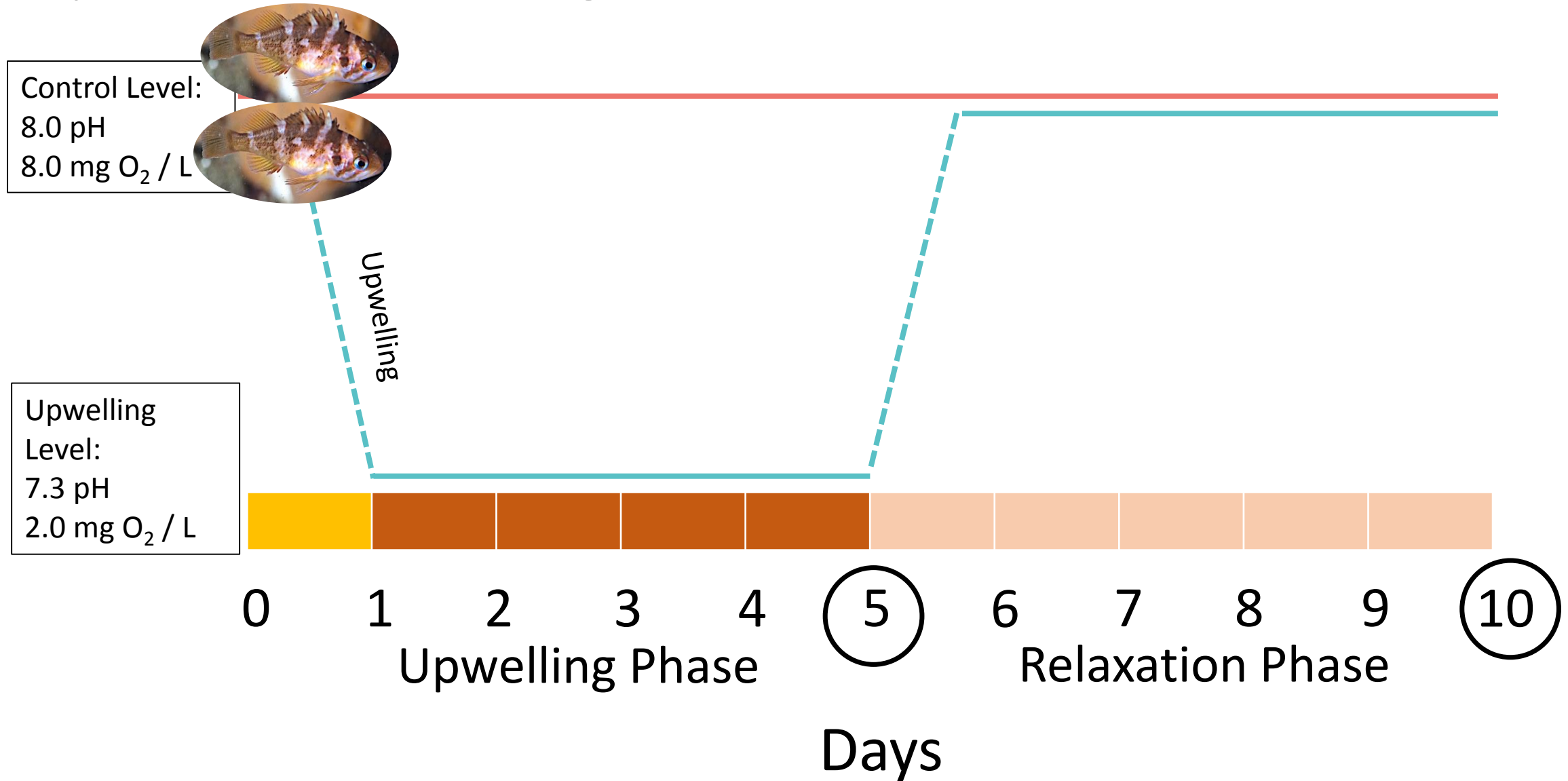
- 8.0 pH
- 8.0 mg O<sub>2</sub> / L

## Upwelling Group

n=10

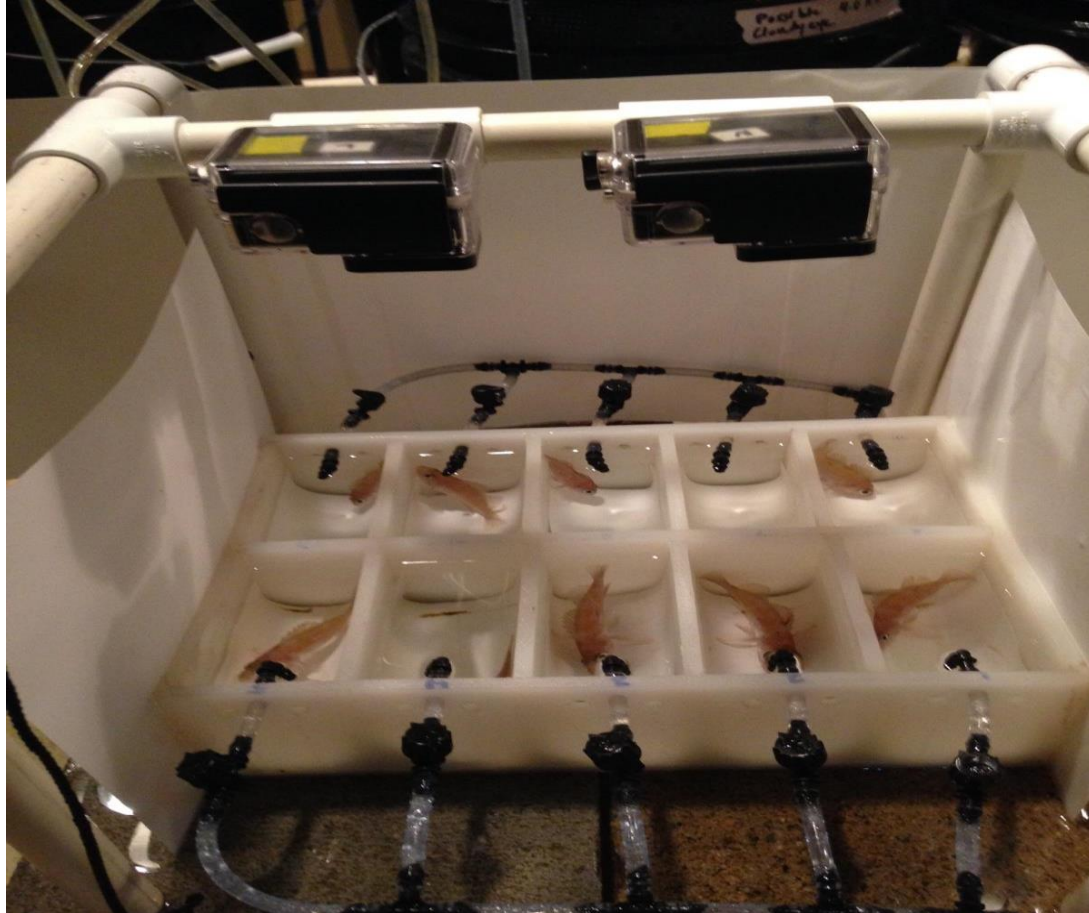
- 7.3 pH
- 2.0 mg O<sub>2</sub> / L

# Experimental Design





# Fish Hammocks and Go Pros



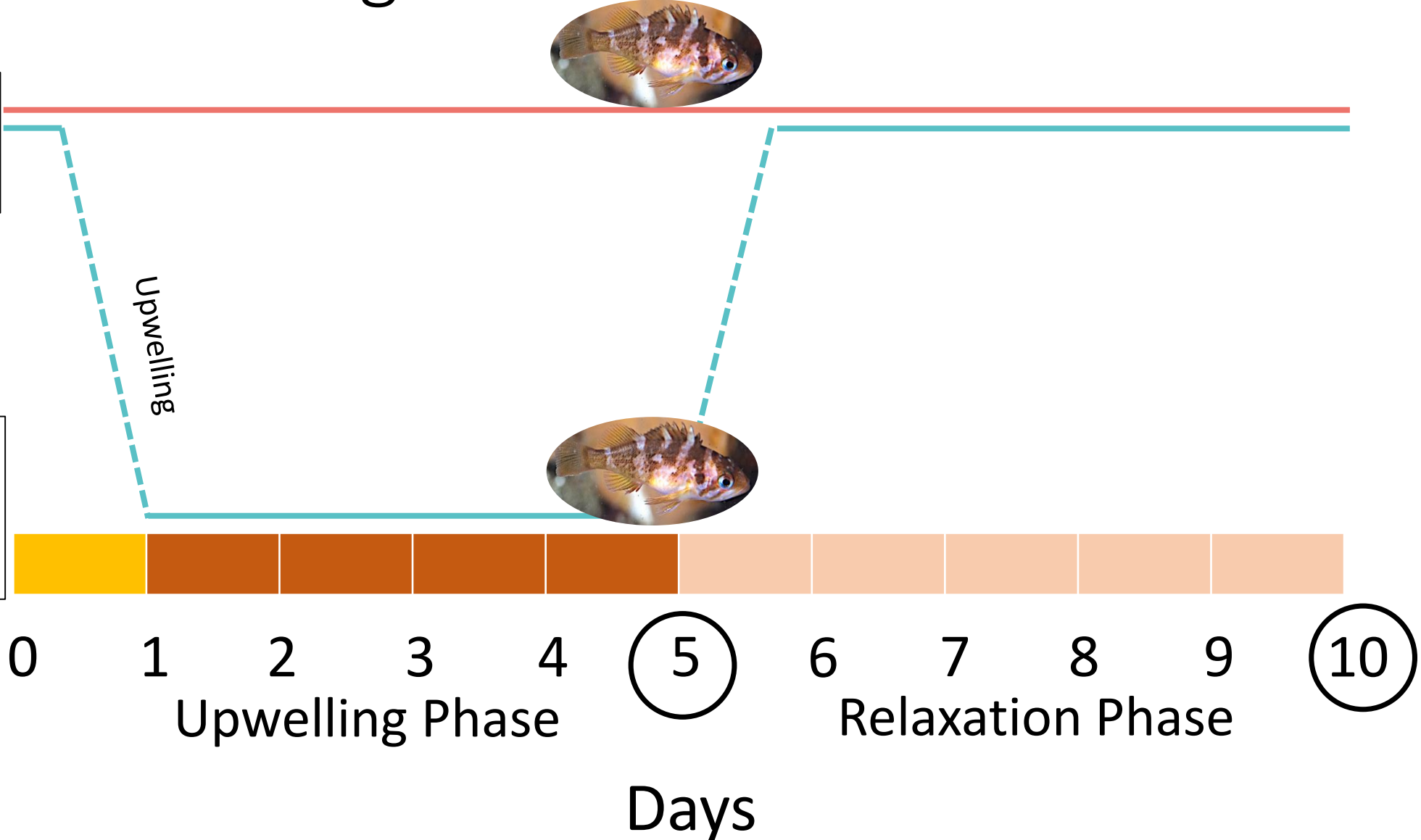
SJSU IACUC protocol # 1007



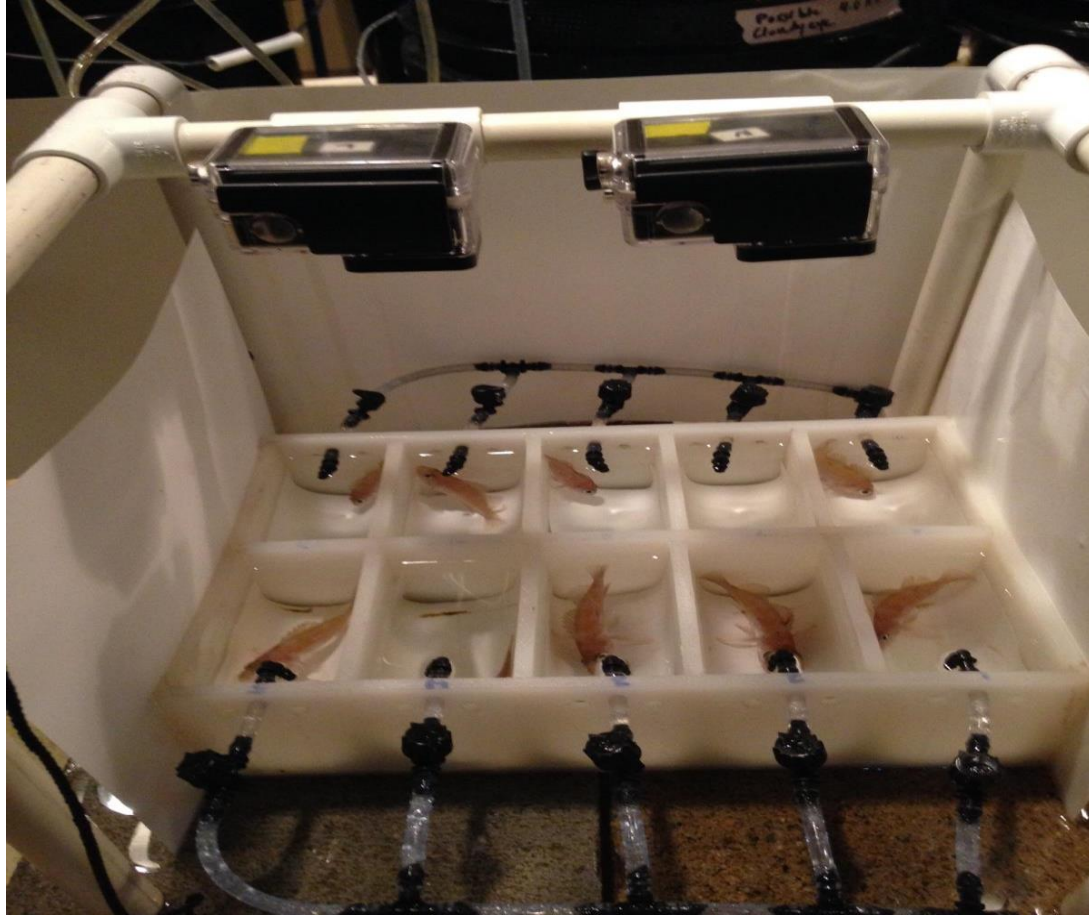
# Experimental Design

Control Level:  
8.0 pH  
8.0 mg O<sub>2</sub> / L

Upwelling Level:  
7.3 pH  
2.0 mg O<sub>2</sub> / L

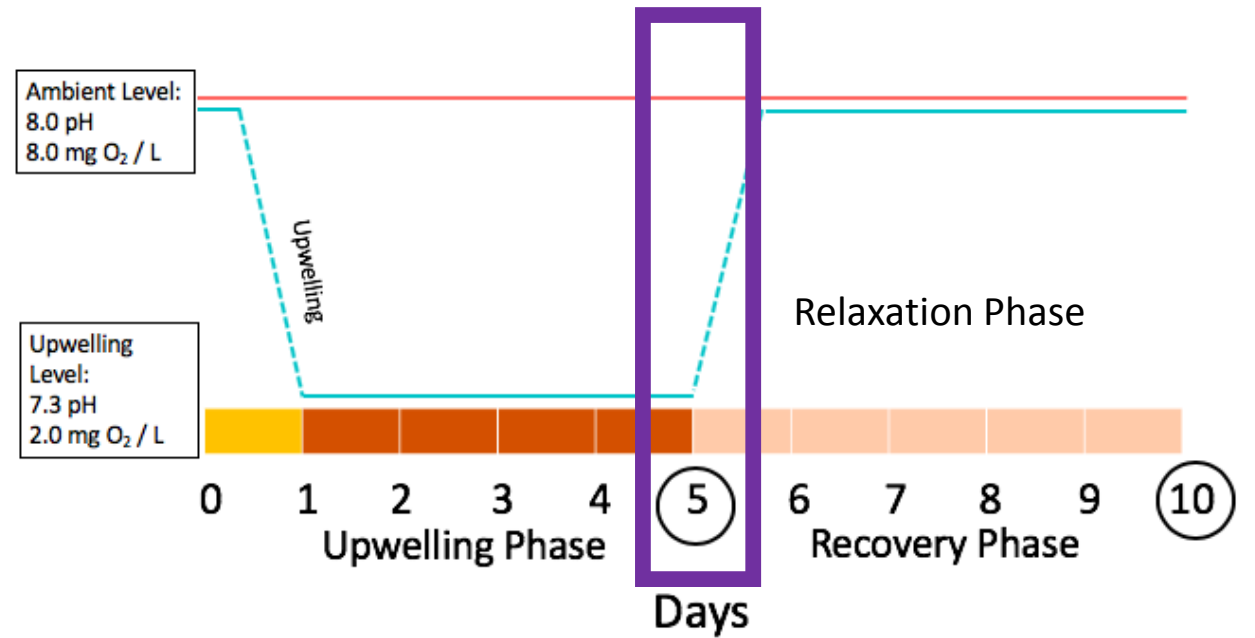
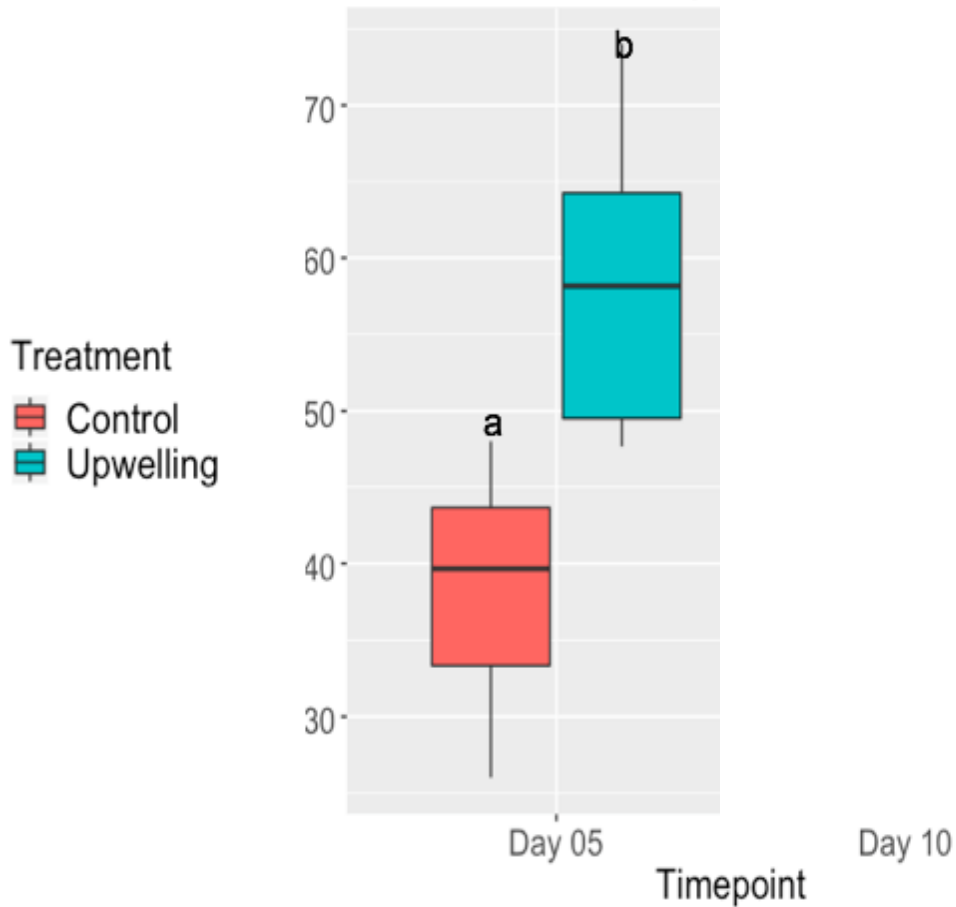


More videos



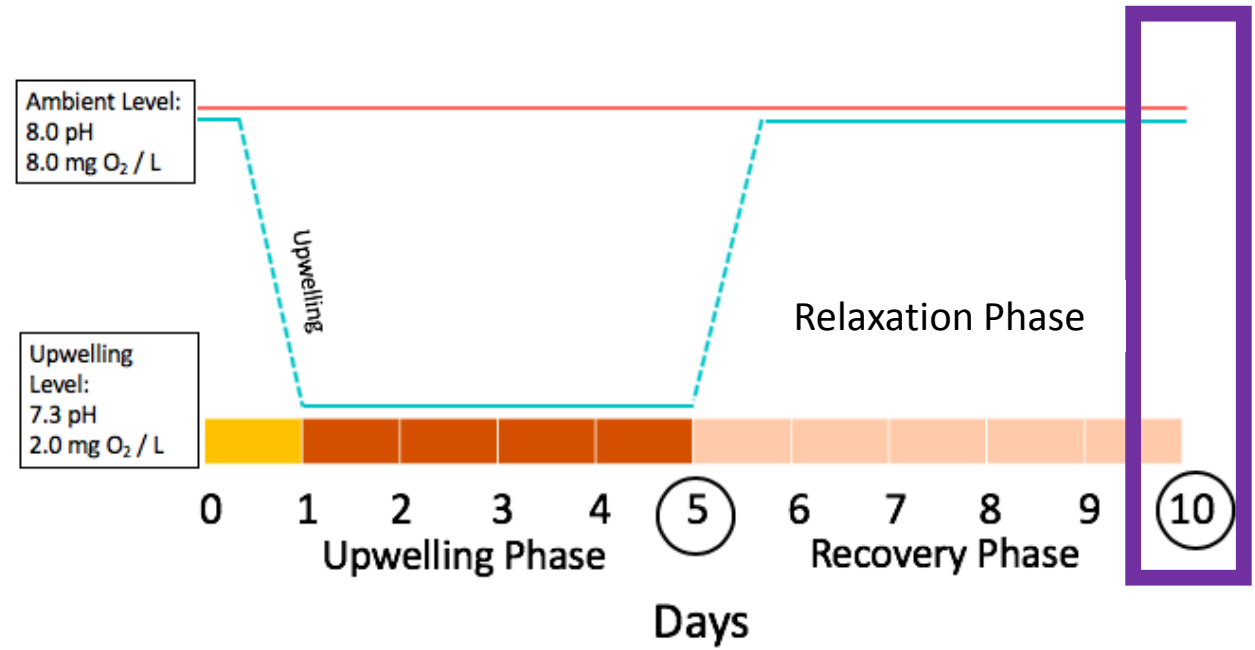
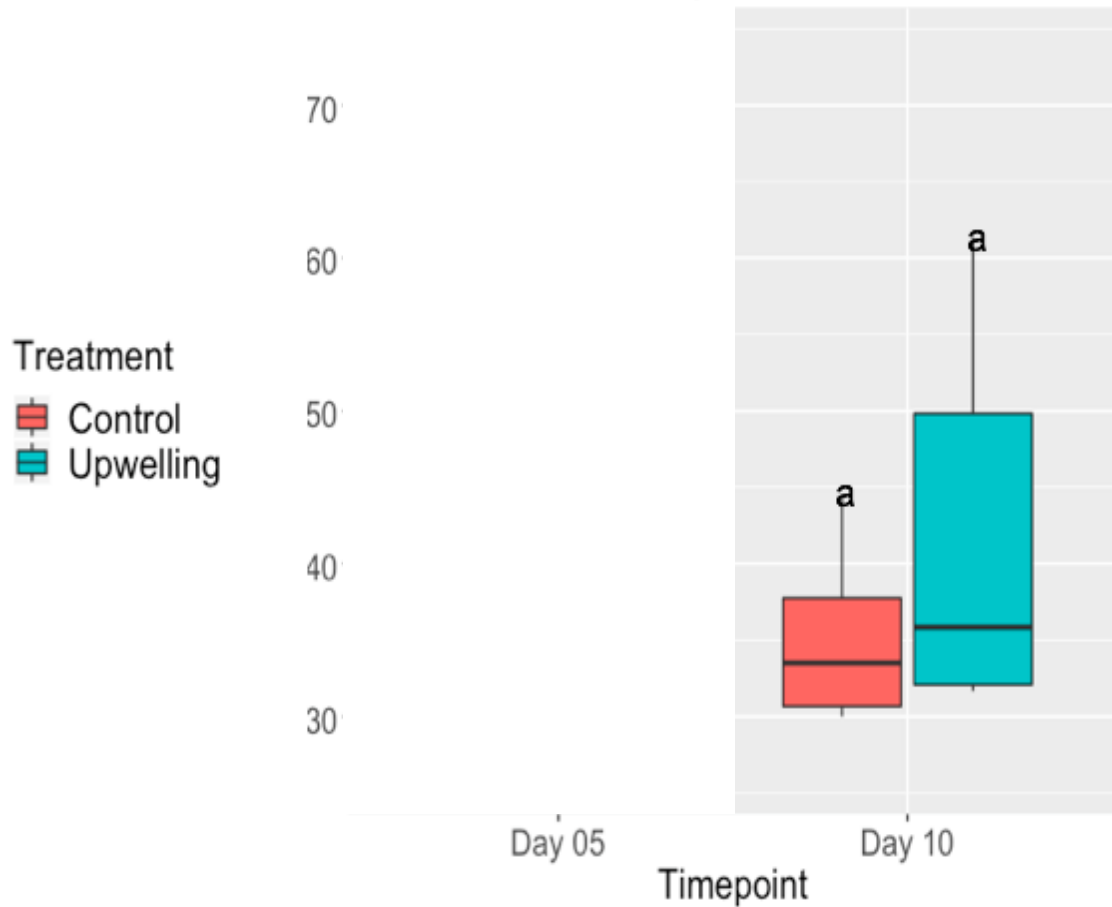
# Results: How did the numbers stack up?

Beats per Minute by Treatment

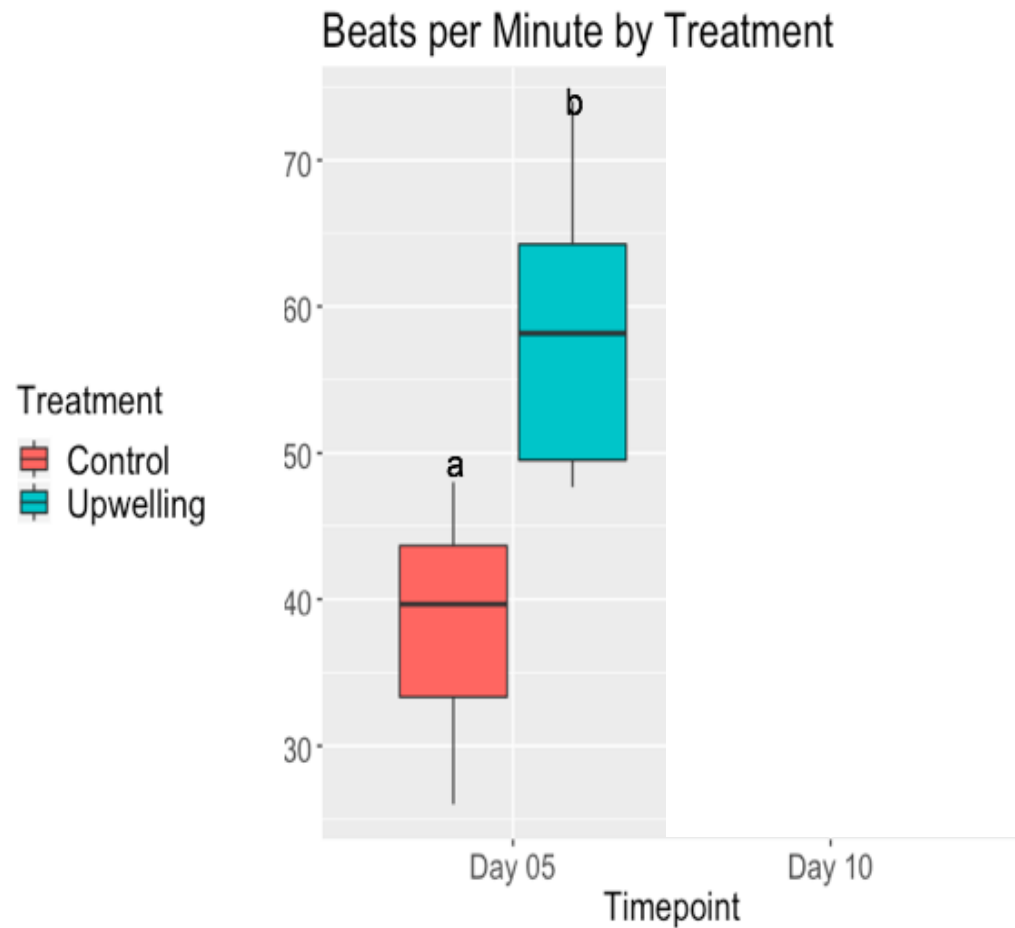


# Results: How did the numbers stack up?

Beats per Minute by Treatment



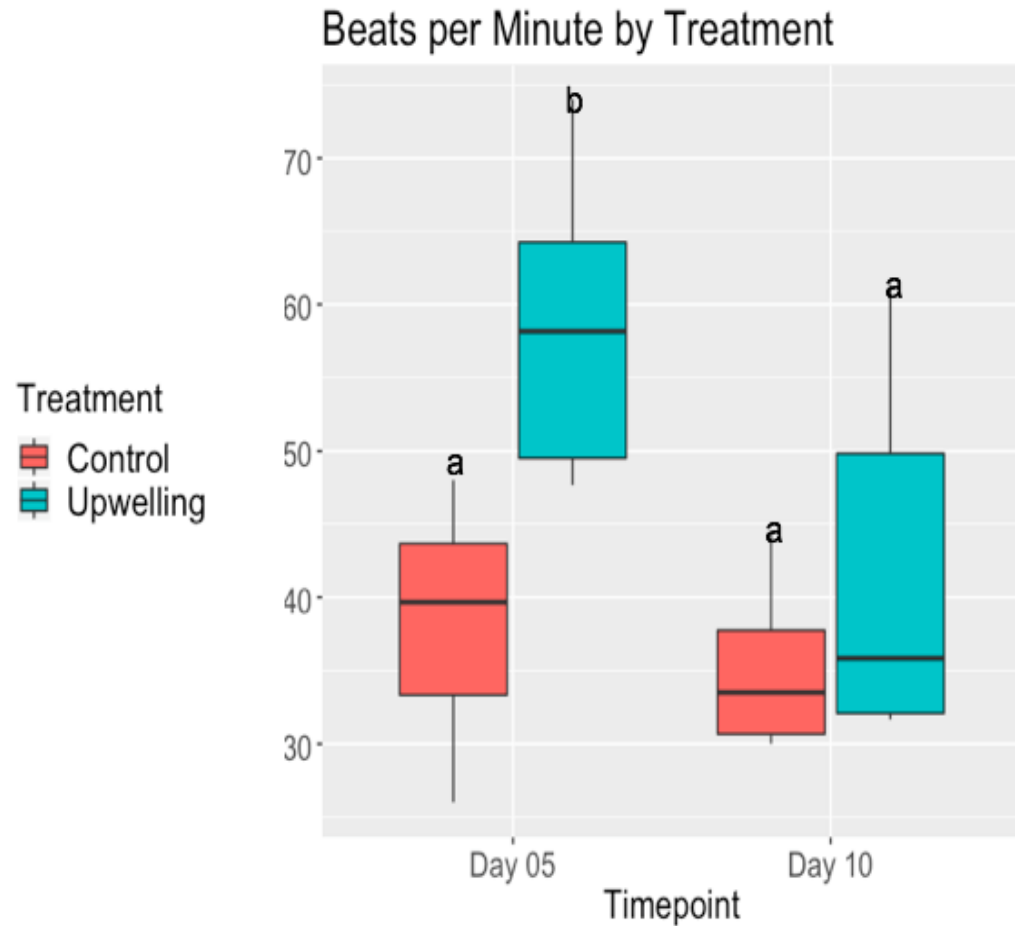
# Discussion: Could they recover?



## Ventilation rates ~50% higher

- Reduced energy available for growth and locomotion, susceptible to predation (energy budget)
- Must compensate for upwelling conditions

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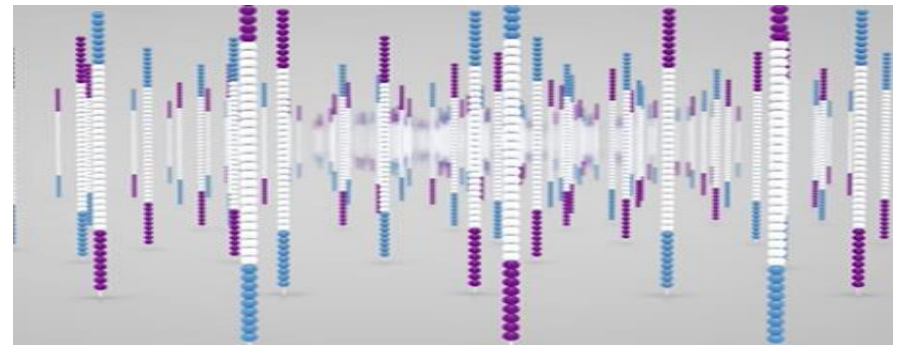
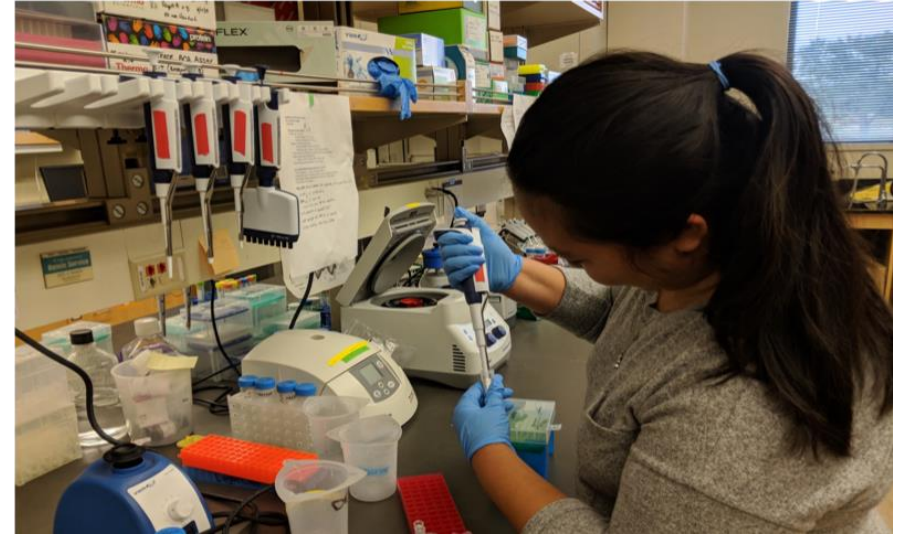
## Ventilation rates return to normal

- Fish appear to recover after extreme upwelling when returned to ambient levels



# Future (Current!) Work

- Quantify metabolic cost of increased ventilation
- Look at effects on the molecular level
- Identify protein activity



# Acknowledgements

- Logan lab members
- Friends and family
- Everyone for listening



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Questions?